Solution Brief

FPGA

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Implementing Next-Generation Data Center Platform Management Using Agilex™ 3 and Agilex 5 Devices

With small form factors and high I/O counts, the cost-optimized, low-power, and highly flexible Agilex™ 3 and Agilex 5 FPGAs and SoC FPGAs provide the capabilities and features required by next-generation platform management solutions.

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Introduction

The architectures of the servers used in data centers are constantly evolving to address the computational, memory, and bandwidth requirements of advanced applications such as artificial intelligence (AI), machine learning (ML), deep learning (DL), and high-performance computing (HPC). Based on Open Compute Project (OCP) specifications[1], server architectures are becoming increasingly modular to facilitate reuse and upgradability.

FPGAs facilitate modular designs that can work across multiple platforms, including compute, accelerators, storage, and switches. Furthermore, the reprogrammable nature of these devices means they can adapt to evolving platform demands without the need to redesign or rebuild complex components.

Intel platform management devices target a broad range of system architectures based on CPUs, GPUs, IPUs, DPUs, FPGAs, and other accelerators collectively referred to as xPUs. These xPUs target a wide range of applications and workloads. In addition to supporting various xPU systems, Intel platform management devices are vendor-agnostic and can implement the control, security, and management functions of any x86, Arm, RISC-V, and proprietary processor-based servers and accelerators.

To ensure competitive xPU systems, when selecting components for platform management solutions, multiple criteria are considered, including availability, supply chain resiliency, security, and I/O density.

Current data center servers employ Intel® MAX® 10 FPGAs and other existing Intel FPGA families to implement their platform management functions. Intel is introducing Intel Agilex® 3 and Intel Agilex 5 FPGAs and SoC FPGAs to provide the next generation of competitive devices to power the platform management solutions of the future.

Figure 1. Intel Agilex FPGA portfolio expansion.

Intel Agilex FPGA Portfolio Expansion

Intel Agilex 3 and Intel Agilex 5 FPGAs and SoC FPGAs extend the Intel Agilex FPGA portfolio with lower power, smaller form factors, and lower logic densities preferred for platform management applications. Figure 1[2] shows the Intel Agilex FPGA portfolio expansion.

The Intel Agilex 3 FPGA family is ideal for high-volume, power-constrained applications that require cost-optimized devices in small-footprint packages. These devices are successors to the Intel MAX 10 FPGA family.

Meanwhile, the Intel Agilex 5 product family includes the recently announced E-Series devices, designed to deliver high performance with lower power consumption in smaller form factors. These devices are successors to the Cyclone® V, Intel Cyclone® 10, and Intel Arria® 10 families.

These new devices will power the platform management solutions of the future while also satisfying the demands of a wide range of other applications.

Industry-Leading Resilient Supply Chain

Intel Agilex FPGAs are built with advanced Intel process technologies using Intel's geographically diverse and resilient manufacturing footprint. As part of our IDM 2.0 strategy[3], Intel is making significant investments worldwide – especially in the United States and the European Union – in leading-edge process nodes, substrate and chip packaging technologies, and assembly and test capacity. At the same time, we are investing in older legacy nodes that are just as important for many of our customers.

Intel's FPGA strategy is fully aligned with IDM 2.0, a key differentiator from other FPGA companies. Intel is the only FPGA supplier with an internal factory network and close partnerships with external foundries. This means Intel is uniquely positioned to choose process technologies and fabrication facilities that deliver the optimal mix of features and performance at the right cost and with the most resilient supply chain.

In addition to traditional product considerations, we are constantly evaluating and making product definition and engineering decisions based on supply chain factors. Furthermore, to satisfy our customers' needs – both today and in the future – and to meet the expectations of supply predictability and agility, we are proactively fortifying and strengthening our end-to-end supply chain. Using Intel's unique internal manufacturing strength, which provides supply control and supply security, we lead the industry in supply chain resilience. The benefit of our supply chain resiliency is that customers can depend on Intel to reliably deliver best-in-class order lead times on Intel-manufactured products.

Intel Agilex devices are fabricated, assembled, and tested in-house, providing Intel with tighter control of capacity, manufacturing process, and the supply chain. Today, we are consistently delivering Intel Agilex FPGA products with best-in-class lead times. Built using Intel's process and packaging technologies, Intel Agilex 3 and Intel Agilex 5 FPGAs and SoC FPGAs will benefit from reliable and predictable supply, coupled with excellent lead-time guidance.

In addition, to satisfy the longevity requirements of our customer's end applications, Intel FPGA, SoC FPGA, and CPLD devices offer long product life cycles. Intel is committed to providing long life cycle support for nearly all its FPGA families until at least 2035.[‡]

Modular xPU Platform Management

Intel FPGAs can be used to implement the control, security, and management functions of all xPU system architectures and any x86, Arm, RISC-V, and proprietary processor-based servers and accelerators. Three use cases are as follows.

Platform Management for Server Platforms

The OCP's Hardware Management project's Data Center-ready Secure Control Module (DC-SCM) sub-project workstream has developed a specification for a smaller common form factor DC-SCM[4] for server platform management. According to this specification, the management, security, and control functions are moved from their traditional location on the baseboard to the DC-SCM module, as seen in Figure 2.

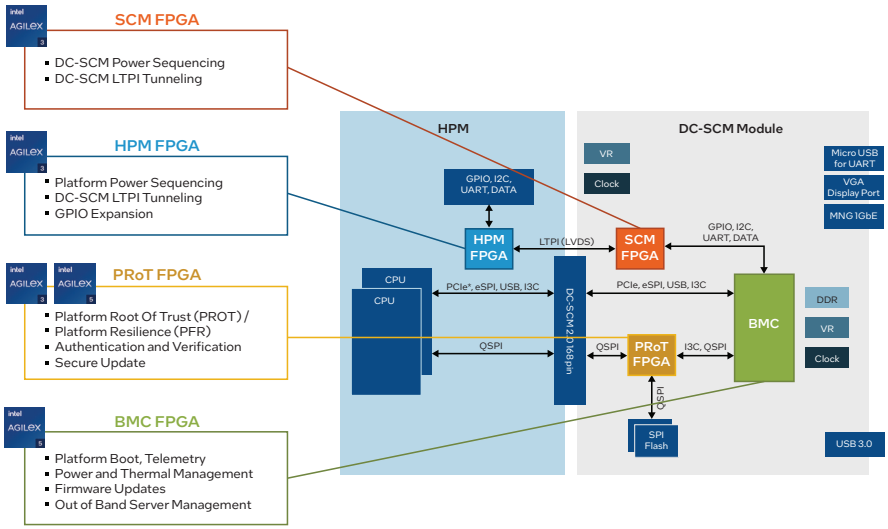

Figure 2. Most platform management functionality is moved to the DC-SCM.

Platform Management for Accelerator Modules

The Open Accelerator Infrastructure (OAI) Sub-Project[5] is under the direction of the OCP Server Project Group. The OAI's OCP Accelerator Modules (OAMs) are hardware accelerators for next-generation AI, ML, DL, and HPC applications.

The OAM specification defines the form factor and standards for the compute accelerator module and a compliant baseboard design, enabling interoperability across multiple ASIC-based or GPU-based mezzanine modules and baseboard design interfaces.

Beyond the modules, a key to this technology is a common motherboard platform called a Universal Baseboard (UBB) that provides connectivity for up to eight modules inside the system and external connectivity, as seen in Figure 3.

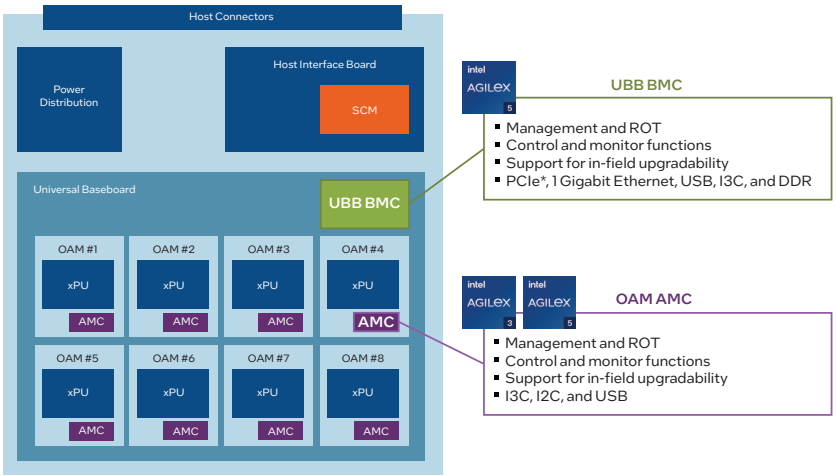

Figure 3. OIA building blocks.

The OAM form factor facilitates scalability across accelerators by simplifying the system solution when interconnecting communication links among modules compared to a PCIe add-in card form factor.

Each OAM is equipped with an Add-in card Management Controller (AMC), which acts as its hardware Root of Trust (HW RoT) and is responsible for controlling, monitoring, and in-field upgrading.

Platform Management for Accelerators/Add-in Cards

As illustrated in Figure 4, xPUs in the form of DPUs, IPUs, SmartNICs, or adapter cards are auxiliary processing units that run inside a data center server or appliance and help offload and accelerate specialized tasks, thereby freeing up CPU cores for improved application performance.

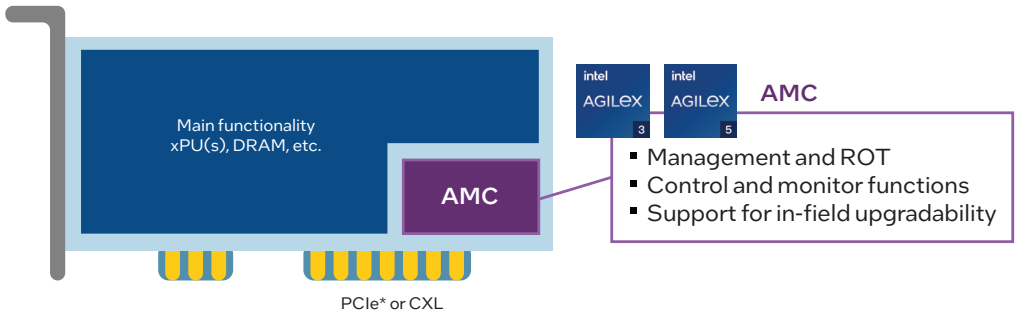

Figure 4. Add-in card with AMC.

Similar to the OAMs discussed in the previous section, each Add-in card is equipped with an AMC, which acts as its HW RoT and is responsible for controlling, monitoring, and in-field upgrading.

Intel utilizes its vast experience in data center architectures and implementations to support all aspects of platform management. In addition to providing all the key building blocks in the form of silicon chips, namely CPUs, GPUs, NPUs, FPGAs, along with the latest interconnect technologies such as PCIe 5.0, Compute Express Link (CXL), and network interface cards (NICs), Intel also offers a wide variety of accelerator cards, such as GPUs, IPUs, and SmartNICs.

With small form factors, high I/O counts, security, and programmability, the cost-optimized, low-power, and highly flexible Intel Agilex 3 and Intel Agilex 5 FPGAs and SoC FPGAs provide the capabilities and features required by next-generation xPU platform management solutions.

The Intel Agilex 3 Product Family

The Intel Agilex 3 product family extends the Intel Agilex FPGA portfolio to lower density, lower power, and smaller form factors to satisfy the demands of high-volume and cost-sensitive applications.

Intel Agilex 3 FPGAs B-Series are designed for xPU platform management, board system management, I/O expansion, and more.

Meanwhile, Intel Agilex 3 FPGAs C-Series will deliver a broad range of capabilities to address a wide range of FPGA and CPLD applications.

The Intel Agilex 3 device family is manufactured in Intel fabs, providing predictable lead times and supply resiliency.

The Intel Agilex 5 Product Family

Intel Agilex® 5 SoC FPGAs E-Series are designed to deliver power-efficient performance in small form factors.

Equipped with advanced security features and a hard processor subsystem, and supporting high-bandwidth PCIe 4.0 connectivity, these devices are ideal for applications such as Platform RoT (PRoT), Platform Firmware Resiliency (PFR), board management controllers (BMCs) and Add-in card management controllers (AMCs).

Advanced Security

Intel Agilex 5 FPGAs and SoC FPGAs are built with advanced security features managed by the secure device manager (SDM). The dedicated SDM has hardened crypto intellectual property (IP) cores and support critical security features such as secure boot, bitstream authentication, encryption, attestation using the Security Protocols and Data Models (SPDM) protocol, anti-tamper protection, secure key provisioning, and physical unclonable function (PUF) key storage and more. With evolving security standards, these features not only help future scalability of HWRoT/PRoT/PFR designs for xPU platforms, but also maintain longevity across multiple generations.

Advanced HPS

Intel Agilex 5 SoC FPGAs introduce an advanced hard processor system (HPS) to the Intel Agilex device families. This upgraded HPS incorporates two 32/64-bit Arm Cortex*-A76 operating at 1.8 GHz and two 32/64-bit Arm Cortex-A55 processor cores operating at 1.5 GHz.

The HPS also incorporates many hard peripheral IP blocks to support a wide range of GPIO and other interfaces, such as USB 2.0, USB 3.1, I2C, I3C, SPI, UART, 10/100/1000 Mbps and 2.5 Gbps Ethernet MAC, and Time-Sensitive Networking (TSN). These cores can interface with DDR4, LPDDR4, and LPDDR5 hard memory controllers.

AI Acceleration

Intel Agilex 5 FPGAs and SoC FPGAs E-Series feature enhanced digital signal processing (DSP) blocks with tensor mode for even greater AI efficiency, which enables new features such as AI-driven predictive failure monitoring and security anomaly detection.

The Intel Agilex 5 product family is manufactured in Intel fabs, providing predictable lead times and supply resiliency.

Conclusion

With small form factors, high I/O counts, security, and programmability, the cost-optimized, low-power, and highly flexible Intel Agilex 3 and Intel Agilex 5 FPGAs and SoC FPGAs provide the capabilities and features required by next-generation xPU platform management solutions.

In addition to supporting various xPU systems, Intel platform management devices are vendor-agnostic. They can implement the control, security, and management functions of any x86, Arm, RISC-V, and proprietary processor-based servers and accelerators.

Intel is beefing up its supply chain by investing in supply programs and our portfolio to enable an unmatched customer supply experience. These investments and actions help provide the supply predictability, agility, and longevity that customers expect, ultimately empowering customers to leverage supply as a strategic advantage.

All Intel products are off hard allocation and are operating under normal business conditions in which Intel distribution partners manage customer shipment commitments. Intel is committed to providing long life cycle support for all these device families until at least 2035‡

Built using Intel's advanced process and packaging technologies, Intel Agilex 3 and Intel Agilex 5 FPGAs and SoC FPGAs will benefit from reliable, predictable supply and exceptional lead-time guidance.

References

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2 https://community.intel.com/t5/Blogs/Products-and-Solutions/FPGA/Learn-About-the-Intel-Agilex-FPGA-Portfolio-Expansion/post/1435829

3 https://www.intel.com/content/www/us/en/newsroom/news/idm2-strategy-defined-60-seconds.html

4 https://www.opencompute.org/documents/ocp-dc-scm-2-1-0-97-pdf

5 https://www.opencompute.org/wiki/Server/OAI

Learn More

Intel FPGAs and SoC FPGAs page

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‡Intel is committed to provide long life cycle support for all product families (except for HBM2-based devices of Intel Stratix® 10 MX, NX, DX, and configuration devices [EPCQ-A]) until 2035. However, in the event of unforeseen supply disruption, such as vendor discontinuance, change in government regulations or production tools obsolescence, Intel will inform its customers.

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